SNOWSHOE HARE ABUNDANCE IN THE WISEMAN AREA OF GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE, ALASKA

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DONNA L. DIFOLCO, U.S. National Park Service, 201 First Avenue, Fairbanks, Alaska 99701

INTRODUCTION

The cyclic nature of the predator-prey relationship between snowshoe hare (*Lepus americanus*) and lynx (*Lynx canadensis*) has been well documented (Elton and Nicholson 1942, Brand et al. 1976, Brand and Keith 1979). Wide swings in the hare population are followed by corresponding highs and lows in the lynx population. Trapper effort and success in capturing lynx often reflect this furbearer's local population level. However, since trapper success and effort is also influenced by variations in weather, fur prices, knowledge of and experience in the area, and other personal factors, predicting lynx population highs and lows using trapper reports is difficult. Knowledge of snowshoe hare densities may give park managers a better indication of where the lynx population may be heading.

In eastern Gates of the Arctic National Park and Preserve (GAAR) and adjacent lands, the trapping of furbearers, including lynx, provides the economic base for many local residents. While the National Park Service (NPS) is mandated to "...provide for the maintenance of sound populations of, and habitat for, wildlife species...," park managers must also "...protect the resources related to subsistence needs..." (Alaska National Interest Lands Conservation Act). Nevertheless, the primary objective for the park is "...to maintain the health of the ecosystem..." (Congressional Record H-10549, Nov. 12, 1980). These directives prescribe that park resource managers play an active role in monitoring fluctuations in wildlife populations as well as trapping activity and its influence on furbearer populations. Furbearer and prey species studies and trapper questionnaires are tools managers can use to monitor and protect these natural and subsistence resources.

To gain an understanding of the health of the furbearer populations in eastern GAAR, Resource Management staff completed a 5-year furbearer study in 1993, which collected information on the age, sex, health and reproductive characteristics of furbearers trapped in and near the park and preserve (Swanson 1994). Upon the discovery of an unusual sex and age ratio in the lynx population [possibly the result of food stress (low hare densities)], management was advised to: 1) monitor the snowshoe hare population; and 2) identify geographic areas that serve as refugia in times of low hare densities (Swanson 1994). To address the first of these objectives, this study initiated a monitoring program to index snowshoe hare abundance in the park near Wiseman. Suggestions are also made for addressing the second objective, identifying areas that serve as hare refugia.

I wish to thank all those who helped in this project: Dave Schmitz, my expert field assistant, Craig Johnson, who piloted the supercub for the aerial photos, Howard Golden, who established the methods used in this study, and the people of Wiseman, for sharing their intimate knowledge of the wildlife in the area. I also thank Shelli Swanson for her assistance in the preparation of this report.

STUDY AREA

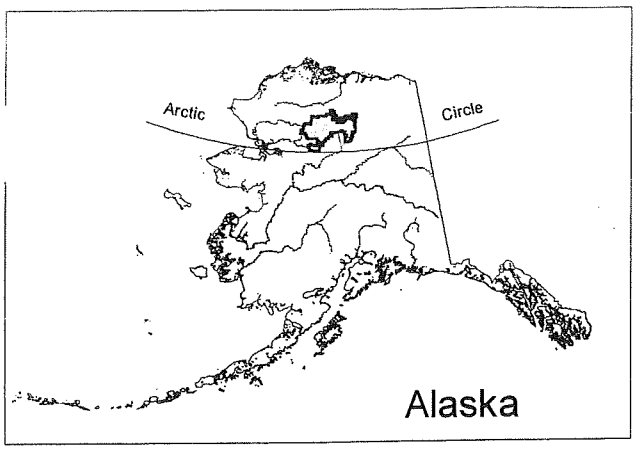
Gates of the Arctic National Park and Preserve is located above the Arctic Circle (66° 33' N latitude) in the central Brooks Range, Alaska (Fig. 1). Two climate zones occur in the park and preserve: the subarctic zone at lower elevations south of the continental divide and the arctic zone to the north and at high elevations. Precipitation is low within the park and preserve and yearly averages fall between 30 - 45 cm in the west and 13 - 25 cm in the north (National Park Service 1986). Snowfall averages south of the divide range between 152 - 203 cm and averages of 89 - 127 cm are typical in the north. Yearly temperatures in the south fluctuate from an average July maximum of 21° C (70° F) to an average January minimum of -34° C (-30° F). Temperatures in the north fluctuate from an average July maximum of 18° C (65° F) to an average February minimum of -23° C (-10° F).

Boreal forest, tundra, and shrub thicket are the major vegetation communities in the park and preserve (National Park Service 1986). The snowshoe hare study area lies in the boreal forest, which covers the southern flanks and valleys of the Brooks Range and is composed of black spruce (*Picea mariana*), white spruce (*P. glauca*), paper birch (*Betula papyrifera*), shrub birch (*B.* glandulosa), aspen (*Populus tremuloides*), and balsam poplar (*P. balsamifera*). Willow (*Salix* spp.) and alder (*Alnus* spp.) thickets up to 3.5 m in height occur along stream channels and gravel bars. The study was conducted near the eastern park boundary north of Wiseman (Fig. 1).

METHODS

Field Methods:

Aerial photos of the study area were taken on February 24, 1997. A 35mm camera with 52mm lens, and 400 ASA color print film was used. The NPS supercub flew 70 mph at about 800 ft above ground level. The photos were used to divide the study area into winter vegetative cover and composition (VCC) classes (Golden 1994). Existing aerial photos could not be used because they were taken from too high an altitude and only during snow-free months. VCCs fell into 1 of 3 cover classes: light, 10-24% vegetation cover; moderate, 25-59% cover; or dense, 60-100% cover (scarce, 0-9% cover, was not found on the study route). Each cover class was subdivided by species composition (listed in order of dominance). The study area comprised the following 7



Gates of the Arctic
National Park and Preserve

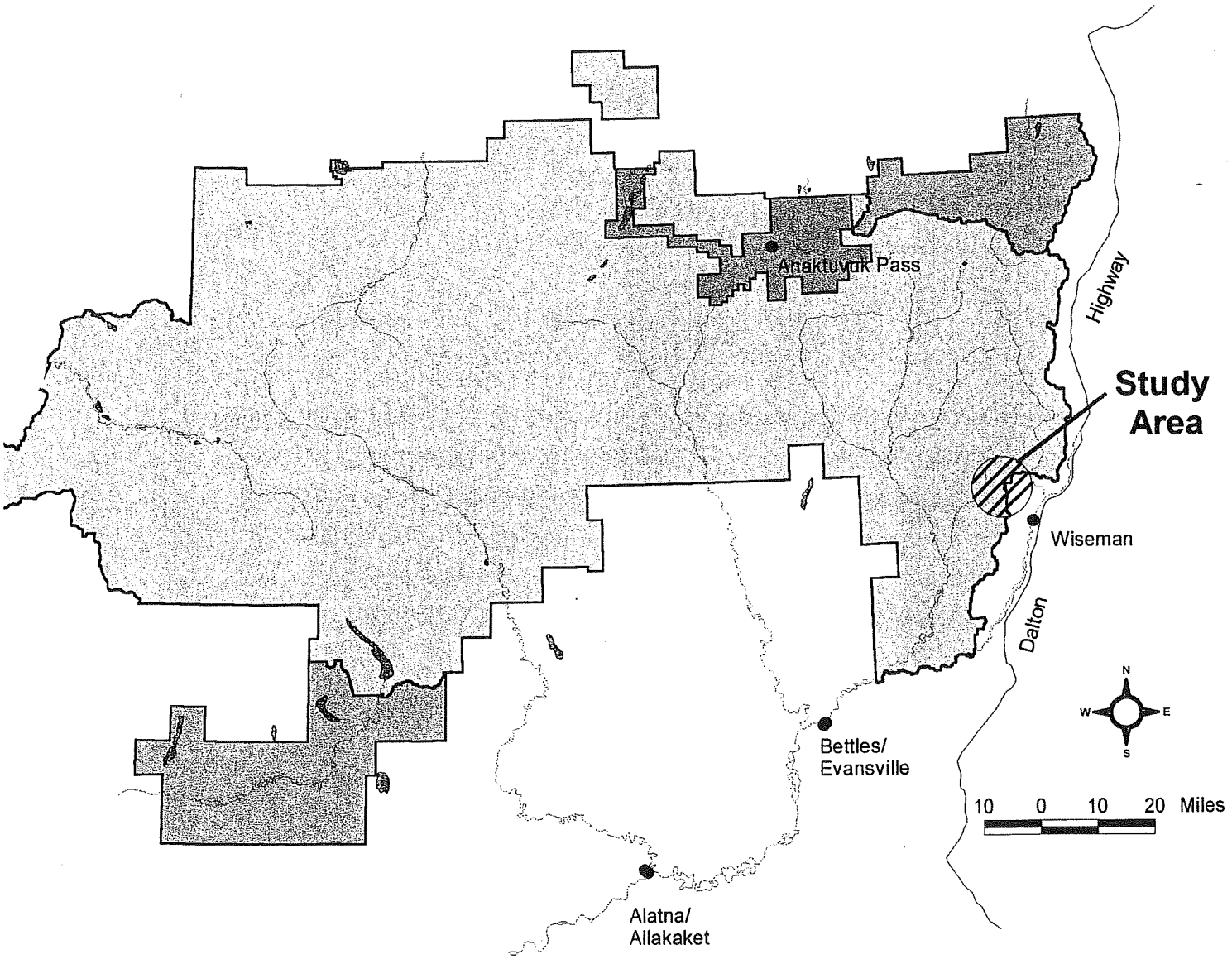


Fig. 1. Location of snowshoe hare track count in Gates of the Arctic National Park and Preserve, Alaska, March 6-11, 1997.

VCCs: light spruce-shrub birch (L-SB); light spruce-willow (L-SW); light willow-alder (L-WA); moderate spruce-willow (M-SW); moderate spruce-poplar-willow (M-SPW); dense willow-spruce (D-WS); and dense willow-poplar-spruce (D-WPS).

Cross-country skis were used to conduct the study March 5 - 11, 1997, using Golden's (1994) method for snowshoe hare track counts. The survey route, about 3.6 km long through 7 VCCs, was marked with flagging, the vegetation was described, and position fixes (using a GPS) were obtained at the start and ending points of each VCC (Fig. 2, Appendix I). Since there had been no fresh snow, all tracks were brushed out on both sides of the survey route. Tracks were counted for the next 6 days (except for the VCC L-SW, which was set up the second day after the first track count; therefore, only 5 counts were recorded on L-SW). When too many hares had passed over the same place to distinguish the number of individual tracks, it was called a trail. Usually, 3 - 4 tracks or more became a trail.

Deposition, the number of snowshoe hare tracks deposited daily, was counted on the right-hand side of the transect. Retention, the number of tracks retained from one day to the next, were noted on the left-hand side. Track deposition was used to calculate the hare abundance index. Track retention data is useful for determining the accuracy of the deposition counts since wind, warm temperatures or precipitation may influence the length of time tracks remain visible. If track retention is low, the abundance index may indicate a lower number of hares than what is actually present. Tracks were brushed out daily on the deposition side of the route. The retention side was brushed out after 3 days to begin a second set of track retention counts. Thus, track retention was counted for two 3-day periods (one 2-day and one 3-day period for L-SW).

Temperature, wind speed and sky conditions were recorded before starting and upon finishing each day's transect. A thermometer was used to record temperature. Sky conditions were observed and noted, and wind speed was estimated using flagging and/or tree branches. A measuring stick was available to record snowfall; however, only one very light dusting of "snow" fell during the survey period.

Statistical Methods:

The means and standard deviations were calculated for the number of snowshoe hare tracks deposited in each VCC for both 3-day count periods and for all 6 days combined. The resulting values were then divided by the length of the respective VCC to determine number of tracks per kilometer for each VCC. The following formulas were used to calculate the mean ($\bar{x}$) and standard deviation (sd):

$$\bar{x} = \frac{\sum x}{n} \qquad sd = \sqrt{\frac{\sum (x - \bar{x})^2}{n(n-1)}}$$

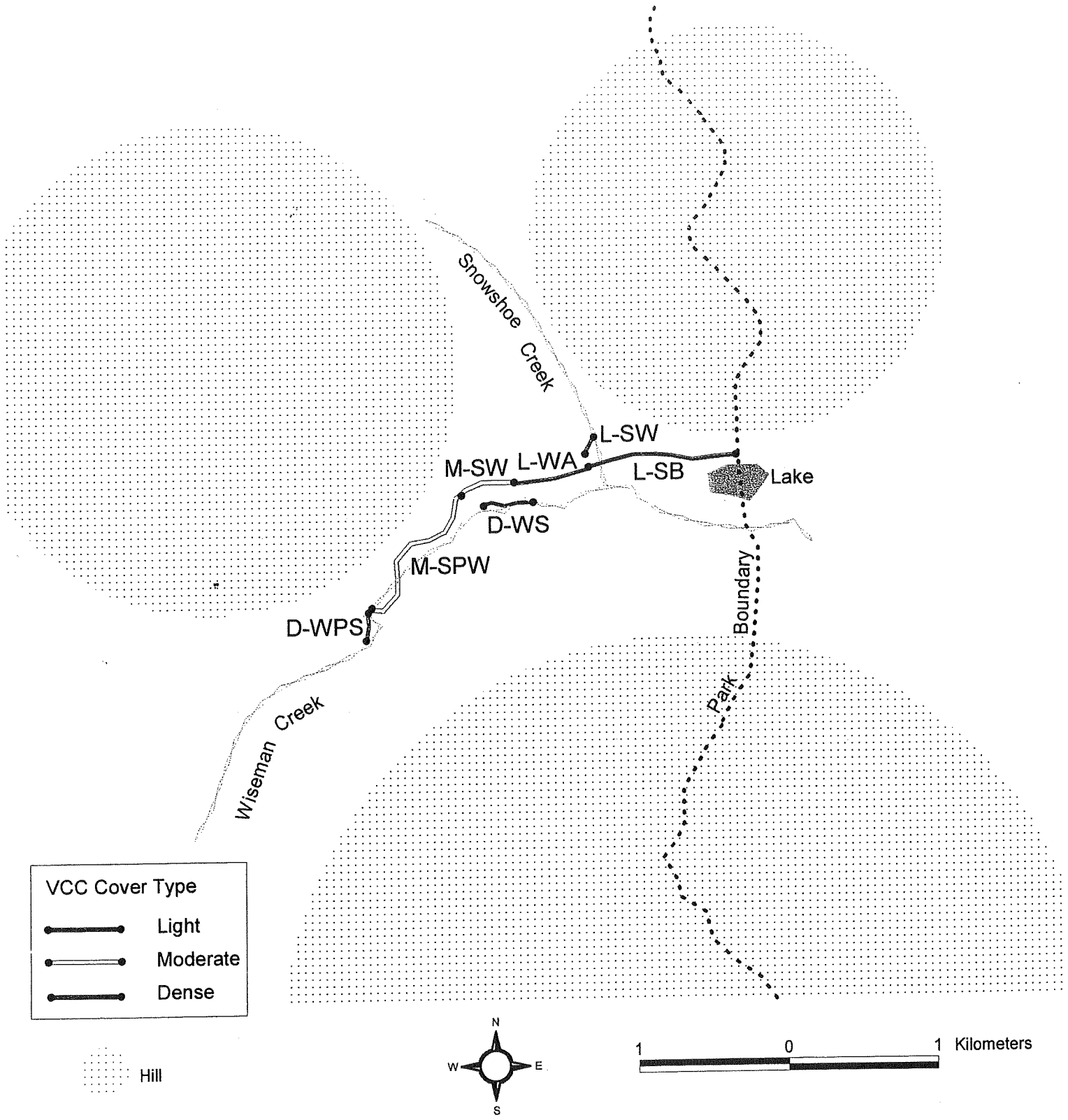


Fig. 2. Diagram of snowshoe hare track count survey route near Wiseman, Alaska, Gates of the Arctic National Park and Preserve, 6 - 11 March 1997. Vegetation cover and composition codes are as follows: L-SB = light spruce-shrub birch; L-SW = light spruce-willow; L-WA = light willow-alder; M-SW = moderate spruce-willow; M-SPW = moderate spruce-poplar-willow; D-WS = dense willow-spruce; and D-WPS = dense willow-poplar-spruce.

where $\sum$ means sum, x is the number of tracks counted each day and n is number of sample days (6 for all VCCs except L-SW, which = 5).

In addition, 90% confidence intervals were calculated for the average number of tracks deposited per km in each VCC for all 6-days of the survey using the following formula:

$$\bar{x} \pm \frac{sd(t_{.10})}{n^{1/2}}$$

where $t_{.10} = 1.476$ for all VCC sampled for n = 6 days; for L-SW, $t_{.10} = 1.533$ for n = 5 days.

RESULTS

Track Deposition:

Track deposition ranged from a daily average of 7.3 tracks/km in L-SB to 285.0 tracks/km in D-WPS (Fig. 3). More tracks were deposited per kilometer in the 2 dense VCCs than in either the moderate or light VCCs ($p = 0.10$). In the light VCCs, L-WA had similar results as L-SB, with 9.6 tracks/km deposited each day. Contrarily, there were 50.0 tracks/km deposited in L-SW, which is not significantly different from that found in the moderate VCC M-SW, with only 37.5 tracks/km ($p = 0.10$). Results intermediate between dense and light VCCs were found in M-SPW, wherein 126.8 tracks/km were deposited daily.

Track Retention:

Tracks remained visible throughout the study period. Individual tracks, however, were obliterated as more hares (or the same animal) followed on the same path. In the dense VCCs, trails had developed by the second day in both count periods. Trails also had developed by the second day in M-SPW. However, in M-SW (which had a relatively low deposition rate), only 5 trails were counted on the third day in the first 3-day period and none in the second 3-day period. No trails developed in the light VCCs throughout both 3-day periods.

Weather and Other Notes:

No snow fell during the 6 days of the track count except for a very light dusting which fell the night after the third count. The temperature remained cold throughout the study period, ranging from -20^0 F on the coldest morning to 10^0 on the warmest afternoon. The wind was usually calm, although breezes were estimated at about 8 mph on one day (Appendix II).

Although browsed stems were not measured (diameter at point of browse or height of browse line), a moderate amount of browsed vegetation was noted in the dense VCCs. The only hares actually observed during the study were in the 3 VCCs which had the highest rates of track deposition: the 2 dense VCCs and M-SPW.

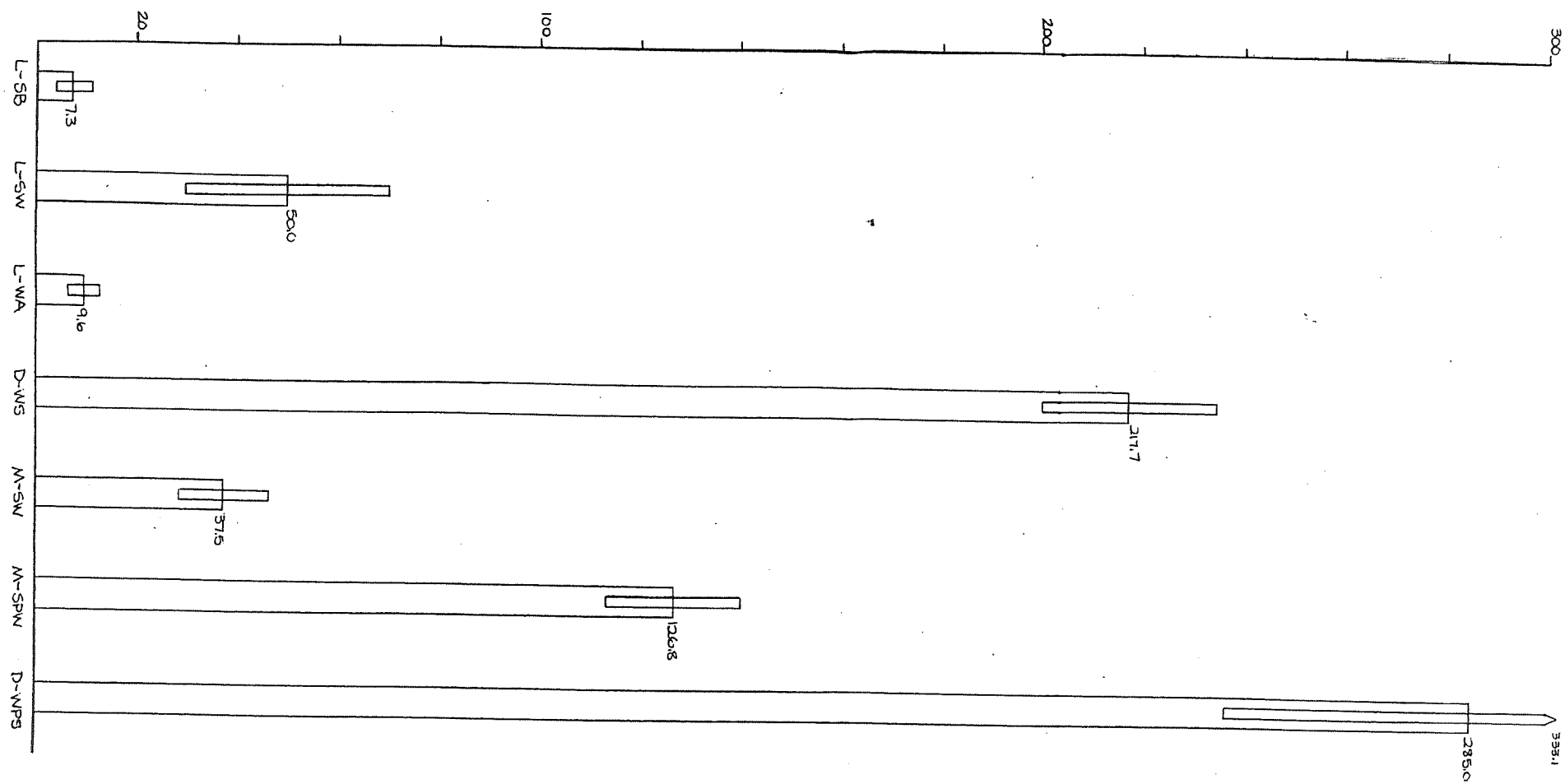


Fig. 3. Average snowshoe hare tracks/km in each vegetation cover and composition (VCC) type (with 90% confidence intervals) near Wiseman, Alaska, Gates of the Arctic National Park and Preserve, 6 - 11 March 1997. VCC codes: L = light, M = moderate, D = dense cover; S = spruce, B = shrub birch, W = willow, A = alder, P = poplar.

Other animal tracks encountered along the survey route included fox, ermine, red squirrel, moose, and ptarmigan. No lynx tracks were seen in the area throughout the study period.

DISCUSSION

The results from the 1997 snowshoe hare track count survey in Gates of the Arctic National Park indicate that snowshoe hares are more numerous in dense habitat in winter. We found higher densities of tracks in the dense cover VCCs than in either the light or the moderate cover VCCs. Dense vegetation not only provides better cover and therefore is safer habitat in which hares may feed, it also supports more forage per unit area than less densely vegetated habitat. Wolff (1980) also found that snowshoe hares favored the most dense habitat, with the least dense habitat used only when increasing population pressures forced hares into these less desireable areas.

Locating hares in suboptimal habitat (low density thickets) suggests that the population is rising. At extremely low population levels, hares are found only in "refugia," which play an important role in the survival of local populations. Wolff (1980) hypothesized that spruce or willow-alder thickets provided cover from predators, thus preventing local extinction of the species. J. Reakoff (Wiseman trapper, pers. commun.) observed that hare refugia in the Wiseman area tend to be along brushy south- and southwest-facing slopes, where spring snow melt comes quickly and which have dense willow growth. A reconnaissance to some of these areas in April, 1996, when the snowshoe hare population was lower, showed these areas to have relatively dense populations when compared to adjacent, less favorable habitat (DiFolco, unpubl. data).

The amount of vegetative browsing also reflects hare population levels. Wolff (1980) noted that during peak hare densities, all available habitat, from light to densely vegetated areas, showed signs of severe browsing, with the diameter at point of browse >10 mm. Wiseman residents B. Hicker and J. Reakoff (pers. commun.) have also observed severely browsed vegetation during years when the snowshoe hare population was at a peak. The moderately browsed vegetation in the dense VCCs noted during this study indicate a moderate hare population mostly occupying these safer areas. Although browsed stems were not observed in the less densely vegetated areas, the number of tracks counted in these other areas may be evidence of an expanding population.

The apparent discrepancy of the moderate cover spruce-willow (M-SW) VCC not having more tracks than the light cover spruce-willow (L-SW) VCC may have several explanations. One possibility may be the VCCs were classified incorrectly, and that M-SW should have been classified as a light cover VCC. The area classified as M-SW may have appeared on the aerial

photo to be of moderate cover, but may actually function differently. Although the trees along this part of the transect were relatively large, most of the shrubs underneath the tree canopy were covered with snow, effectively eliminating much cover and browse. Also, this section of the transect followed the snowmachine trail, which tended to avoid the more densely vegetated areas. The 2 dense VCCs and M-SPW, where the greatest densities of tracks were found, were in areas off the established snowmachine trail.

Another explanation of why M-SW had no more tracks than L-SW could be the distance of each to more favorable habitat. L-SW is adjacent to a brushy drainage which is known to be a refugia for snowshoe hares during their cyclic low period (J. Reakoff, Wiseman trapper, pers. commun.). On the opposite side of L-SW is an open area which may be used by hares during the summer months when they forage on herbaceous vegetation and small shrubs (Wolff 1980). L-SW, then, may be utilized more on a year-round basis than other areas, such as M-SW, that are farther away from favorable summer or winter habitat. The summer habitat may be used by hares as late into the season as possible, until forage and cover are buried under snow. Once the summer habitat is no longer available, hares move into the dense spruce forests, to feed on willow, alder and spruce (Wolff 1980) and to seek cover. By March (at the time this study was conducted) when the snow is deep, hares concentrate in as densely vegetated areas as their population levels will allow.

An interesting observation was a characteristic difference between tracks deposited in densely vegetated areas and tracks deposited outside these areas. In the densely vegetated areas, the hares apparently spent more time feeding in localized areas, and only travelling short distances between forage areas, as evidenced by the compaction of the snow and the short intervals between tracks. In the lightly vegetated areas, hares were moving at greater speeds, with long intervals between tracks, suggesting travelling animals. Retention data show that some of these paths through open habitat developed into trails after 2 or 3 days, suggesting that these were common routes between more prime habitats with better cover and forage.

In cold, dry, calm weather, as experienced during this study, tracks may be retained for long periods. Sublimation, precipitation or blowing snow may cause reductions in track retention; in such conditions, track (deposition) counts may produce a less accurate index of hare abundance. A dense hare population may also affect track retention. Once more than 3 or 4 hares have followed the same route, individual tracks may become indistinguishable; thus, an observer may not be able to determine accurately how many hares have deposited the tracks. In years of extremely high snowshoe hare populations, counts of trails (and individual tracks, when possible) may be a useful index to population abundance. Track retention data, therefore, while not used directly in calculating a population index, may be useful for determining the accuracy of an index in any given year.

In summary, the snowshoe hare population in the Wiseman area of GAAR appears to be rising. Our data correlates with observations of Wiseman residents, who said that the hare population had been low during the past few years but was currently increasing again (M. Burroughs, B. Hicker, J. Reakoff, and S. Schoppenhorst, pers. commun.). Continued study on an annual basis may offer further insights into the dynamics of the population. Combining track count data with the knowledge of Wiseman residents can provide a reliable index of snowshoe hare abundance.

MANAGEMENT IMPLICATIONS

The 1997 hare track count represents the first year of data collection to index snowshoe hare abundance in the Wiseman area of the park. The various sources of information obtained during the study indicate a snowshoe hare population increasing from moderately low levels. The track count data, observations of browsing, and comments from Wiseman residents all support this conclusion. Although an actual population estimate cannot be obtained using this type of study method, track count data can serve as a good index of winter or early spring snowshoe hare population levels. When compared with pellet counts and livetrapping, track counts were found to be the least expensive means of examining snowshoe hare habitat use, while still providing similar information (Litvaitis et al. 1985). In addition, area residents can provide invaluable information on hare population levels from current and historic perspectives, and can also offer insights into the dynamic relationships of various species. As the method employed provides only an index, research should continue in order that relative snowshoe hare abundance levels can be established. The following are recommendations for management:

1. Continue the track count survey on an annual basis throughout a complete snowshoe hare cycle. By monitoring the population through a complete cycle, managers will then have a measurement guide against which other populations can be compared in the future. The same study area is recommended for the surveys as it has an appropriate diversity of habitat and would provide long-term continuity in data collection. Also, using the same study area would be the most cost-effective, as the area is easily accessible, thereby reducing logistical complications. Staff can stay at the NPS Marion Creek Ranger Station and drive (or snowmachine) to the start of the transect line. Cross country skis (or snowshoes) work well for the narrow, densely vegetated portions of the survey route.
2. Continue a dialogue with Wiseman residents regarding snowshoe hare and other species' population levels. Community response to the National Park Service's interest in their opinions and knowledge of the area was very positive. During years when field surveys may not be

possible, Wiseman residents could be a valuable source of information on population levels and habitat condition.

3. A longer transect route into the park could be incorporated into this study to monitor levels of predator (lynx, wolverine, wolf) abundance and habitat use, should conditions allow. Either skis, snowshoes or snowmachine could be used for this purpose, depending on the route selected, amount of time allotted for the project, and the skills and abilities of the personnel involved.

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Appendix I. Descriptions, lengths and GPS position fixes of starting points of vegetative cover and composition classes (VCCs) from 1997 snowshoe hare track count near Wiseman, Alaska, Gates of the Arctic National Park and Preserve. Vegetation species are listed in order of dominance in each respective VCC. Lengths were obtained by the GPS unit for L-SB, L-WA, M-SW and M-SPW; for L-SW, D-WS and D-WPS, a 30 m tape was used to measure length.

Description (cover/comp.)	VCC	Length (km)	Latitude	Longitude
light spruce-shrub birch	L-SB	1.0	67^0 27.932' N	150^0 15.998' W
light spruce-willow	L-SW	1.2	67^0 28.057' N	150^0 17.439' W
light willow-alder	L-WA	5.0	67^0 28.010' N	150^0 17.187' W
moderate spruce-willow	M-SW	4.0	67^0 27.892' N	150^0 17.820' W
moderate spruce-poplar-willow	M-SPW	1.1	67^0 27.830' N	150^0 18.400' W
dense willow-spruce	D-WS	3.0	67^0 27.842' N	150^0 17.702' W
dense willow-poplar-spruce	D-WPS	1.8	67^0 27.468' N	150^0 19.249' W

Appendix II. Weather data recorded during 1997 snowshoe hare track count near Wiseman, Alaska, Gates of the Arctic National Park and Preserve.

	Start of Survey				End of Survey			
Date	**Time**	**Temp(^{0}F)**	**Wind**	**Sky**	**Time**	**Temp(^{0}F)**	**Wind**	**Sky**
6 March 97	10:15	-20	0	clear	13:40	0	0	clear
7 March 97	11:05	0	0	clear	13:45	10	0	clear
8 March 97	10:55	5	0	thin overcast	14:05	5	0	thin overcast
9 March 97	10:35	0	0-5	thin overcast*	13:40	5	0-5	clearing
10 March 97	11:15	-10	3-8	clear	13:40	5	2-5	clear
11 March 97	10:40	5	0	thin overcast	12:30	10	0	thin overcast

* Ice crystals precipitating.